ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
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Md Abdul Maleque

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Chapter 005

Comparative Study on the Effect of Plasticizer on Thermal Properties of Polylactic Acid

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Keywords: Plasticizer, Polylactic acid (PLA), Thermal properties.

Abstract. Polylacticacid (PLA) is one of the most potential candidates for the partial replacement of petrochemical based polymers because of its biodegradability and renewability. It shows high tensile strength; unfortunately the brittleness and rigidity limit its applicability like, fibers, films, etc., it is of high interest to formulate new PLA grades with improved flexibility and better impact properties. In order to develop PLA-based biodegradable packaging, the physico-mechanical properties of commercially available PLA should be modified using plasticizers. For this, PLA was mixed with blends of glycerol and oleic acid with different percentage and were characterized by utilization of DSC and TGA techniques. The effect of the addition of plasticizer on the thermal properties of PLA was investigated and the results revealed that glass transition temperature (T_g), crystallization temperature (T_c) and melting temperature (T_m) decreased significantly.

Introduction

In recent decades biodegradable polyesters have received much attention. At the very beginning they were intensively resear for biomedical applications for their biodegradability and biocompatibility. Polylacticacid (PLA) is one of the most studied polymers because it can be produced via fermentation of renewable resources, like sugar beets or corn starch [1–3]. PLAs were initially investigated for drug delivery, sutures and orthopaedic implant applications [4–7]. Recently, considerable efforts have been made to extend the application of PLA to the packaging field [8–11]. PLA represents a good candidate to produce biodegradable packaging because of its good mechanical properties [12].

However, low ductility, toughness and high modulus have limited its application only to the rigid thermoformed packaging industry while for flexible packaging new grades of PLA with specific end-use performances are required. High tensile strength, ductility and flexibility at room temperature, transparency, barrier properties, etc are the most important requirements for packaging materials such as films, food packaging. Attempts have been made to improve the mechanical properties of PLA by copolymerization with other monomers but none of these copolymerization processes is yet economically viable and none is known to produce copolymers on an industrial scale for packaging applications [13–16]. Blending PLA with other polymers/copolymers has also been investigated, however only moderate improvement in mechanical properties was achieved [17–24]. Another way to improve the processability, flexibility and ductility of PLA is the use of plasticizers as for glassy polymers in the plastics industry. The choice of plasticizers to be used as modifiers for PLA is limited by the requirement of the application. Only non toxic substances approved for food contact can be considered as plasticizing agents in food packaging materials. The plasticizer should be compatible with PLA and stable at the elevated temperature during processing.